

The Neurobiology of Trauma:

Trauma's effects on the brain and nervous system development and functioning



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California Center of Excellence for Trauma Informed Care
Santa Cruz • California • November 2016

Disclaimer

- I am not a neurobiologist! This is a layperson's understanding of brain functioning based on published research. I use information from
 1. The Amazing Brain by the Trauma Academy by Dr. Bruce Perry
 - http://childtraumaacademy.com/amazing_brain/index.html
 2. The Body Keeps the Score, Bessel van der Kolk
 3. Janina Fisher's Trauma Informed Stabilization Treatment
 4. Dr. Stephen Porges, The PolyVagal Theory
 5. Harvard University Center for the Developing Child

Q&A

- Define trauma according to SAMHSA:
- A) "Traumatic events overwhelm the ordinary systems of care that give people a sense of control, connection and meaning."
- B) "Interactionist perspective:" person and situation.
- C) "Psychic trauma occurs when a sudden, unexpected, overwhelming intense emotional blow or a series of blows assaults the person from outside. Traumatic events are external, but they quickly become incorporated into the mind"
- D) "Trauma results from event experienced by an individual as physically or emotionally harmful or threatening and that has lasting adverse effects functioning and well-being."
- E) "Traumatization occurs when both internal and external resources are inadequate to cope with external threat"

Q&A

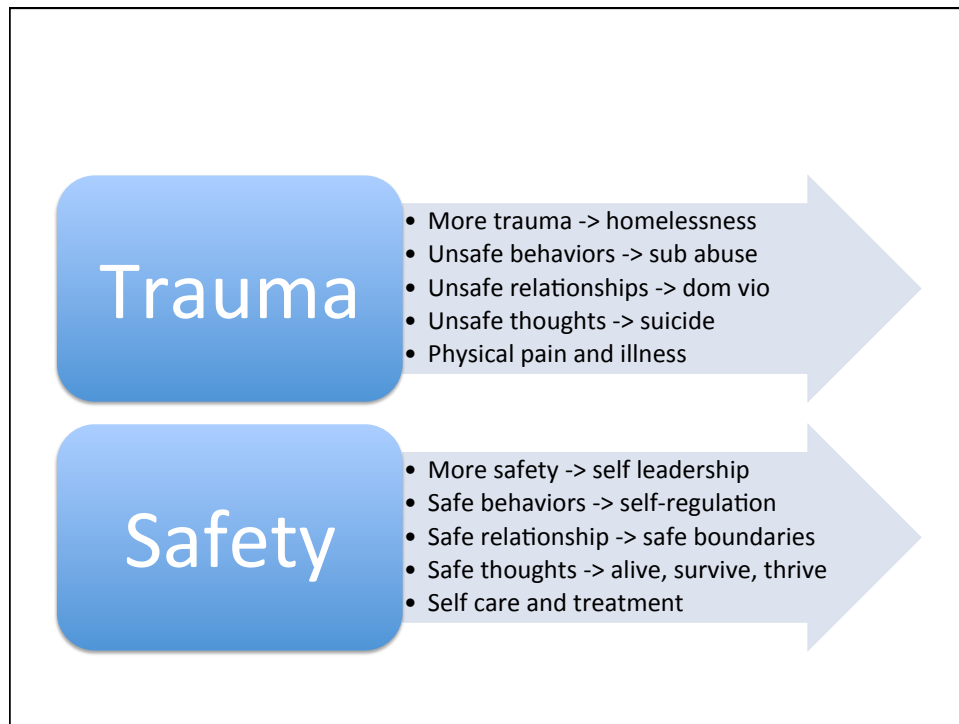
- Define universal precautions:
- A) Everyone has trauma.
- B) Treat and protect everyone equally.
- C) Take a thorough assessment of trauma history with everyone.
- D) Force disclosure.

Q&A

- What are two mechanisms that convert early childhood adversity into biomedical disease?
- A) Traumatic brain injury and psychosis.
- B) Bloodborne pathogens and environmental toxicity.
- C) GMO foods and gluten
- D) Unsafe behaviors and neuro-dysregulation.

Q&A

- What specific effects does chronic neuro-dysregulation have on the human body?
- A) Suppression of the immune system
- B) Activation of pro-inflammatory molecules
- C) Both of the above.
- D) None of the above.



Bodily functions like breathing, circulation, digestion respond to the emotions we actually feel, not to moral precepts. The body sticks to the facts.

- Alice Miller
The Body Never Lies: The lingering effects of hurtful parenting, pg. 33

Mental Health Science

Clinicians and neuroscientists propose a new umbrella discipline they call "mental health science" to marry the benefits of both disciplines by clinicians and neuroscientists working together to understand and improve psychological treatments.

1. Uncover the neurobiological mechanisms of existing psychological treatments.
2. Neuroscience is providing "unprecedented" insights that can relieve dysfunctional behavior—practitioners can use those insights to create new and improved psychological treatments.
3. The next generation of clinical scientists and neuroscientists should work more closely together.

Emily A. Holmes, Michelle G. Craske & Ann M. Graybiel, *Nature Magazine*, 2014

Developmental traumatology

- Aim is to unravel the complex interactions between an individual's genetic [and epigenetic] constitution, their unique psychosocial environment and the proposed critical periods of vulnerability for and resiliencies to maltreatment experiences and to determine how such factors may influence changes in biological stress systems and brain development, thus leading to the known serious consequences of early life stress [later in life].

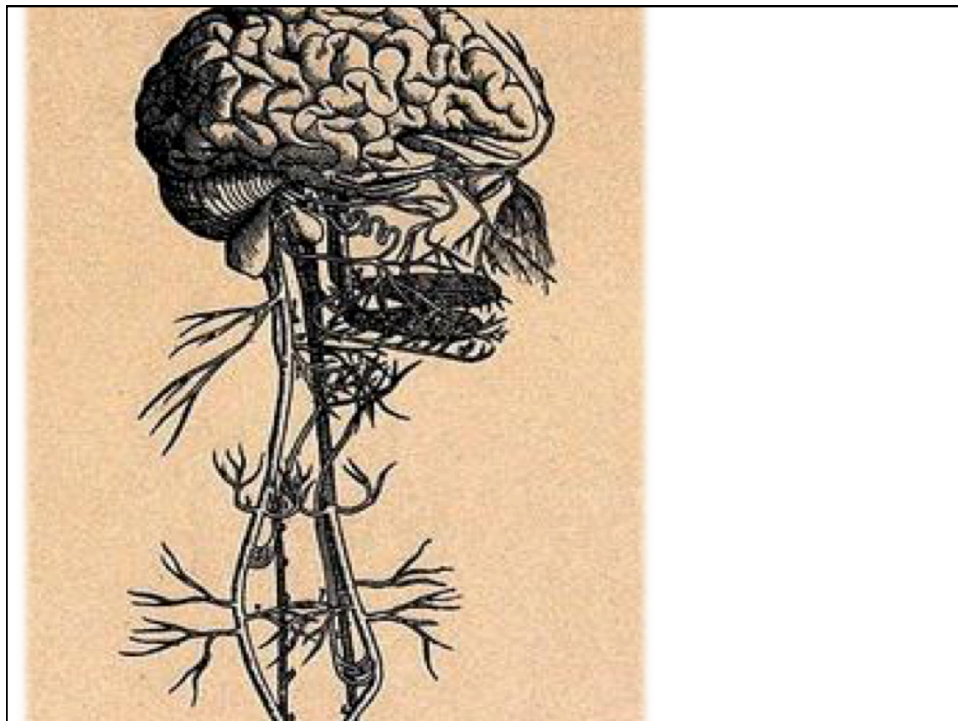
Teicher et al., 2010

...and the brain

“Without understanding the basic principles of how the brain develops and changes, we cannot expect to design and implement effective interventions.”

Bruce Perry, M.D.

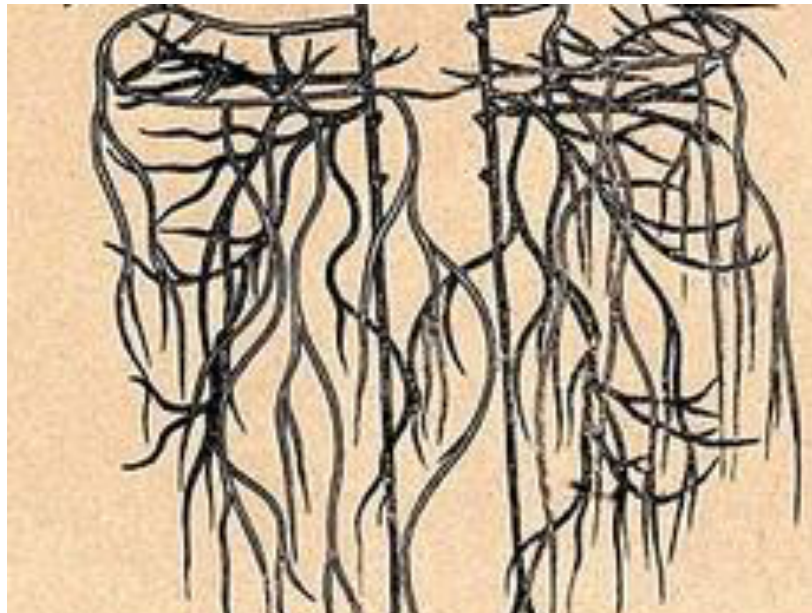
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...the nervous system...

“If treatments are unable to shift the client to a calmer physiological state, then access to the psychological mechanisms and processes that have been the bases of psychotherapy may not be efficiently available.”

The PolyVagal Theory
Dr. Stephen Porges
2011



Trauma...

“Many problems of traumatized children can be understood as efforts to minimize objective threat and to regulate their emotional distress. Unless caregivers understand the nature of such re-enactments they are liable to label the child as “oppositional”, “rebellious”, “unmotivated”, and “antisocial”. “

Bessel van der Kolk
Developmental trauma disorder

Trauma/PTSD ≈ neurological disability

- Complex trauma/PTSD interferes with a person’s ability to store and retrieve information. (**Memory impairments**)
- Trauma interferes with the interpretation and communication functions of the brain, leading to non-verbal communication and misinterpretation of non-verbal signals. (**Interpersonal and communication impairments**)
- Understanding brain development and functioning helps decipher how the person is interpreting the world around him/her. (**Fundamental need for safety to function now**)

SAMHSA

- Individual trauma results from **an event, series of events, or set of circumstances** that is experienced by an individual as **physically or emotionally harmful or threatening** and that has **lasting adverse effects on the individual's functioning and physical, social, emotional, or spiritual well-being.**
- www.samhsa.gov/traumajustice/traumadefinition/definition.aspx



Adult disease

- ACEs are related to adult disease by 2 etiologic mechanisms:
 1. Conventional risk factors that are actually attempts at self-help through largely non-conscious, unsafe strategies. Unsafe behaviors
 2. The effects of chronic stress as mediated through chronic hypercortisolemia, pro-inflammatory cytokines and other stress responses on the developing brain and body systems, dysregulation of the stress response, and pathophysiological mechanisms yet to be discovered. Neuro-dysregulation

"The Relationship of ACEs to Adult Medical Disease, Psychiatric Disorders and Sexual Behaviors: Implications for healthcare," Felitti and Anda in *The Impact of Early Life Trauma on Health and Disease*, Lanius, 2010

Visceral homeostasis

Measure: Heart rate variability

- Stress is observed when behavior becomes disorganized and homeostatic processes are disrupted.”
 - Porges, The PolyVagal Theory, 2010, pg. 63
- Homeostasis reflects the regulation of internal viscera and stress reflects the subjugation of internal needs in response to external needs.
 - Porges, The PolyVagal Theory, 2010, pg. 67
- Individuals exhibiting problems of homeostasis will have the greatest stress vulnerability.
 - Porges, The PolyVagal Theory, 2010, pg. 68

PTSD = nervous system dysregulation

- PTSD is associated with limbic instability alterations in the HPA (hypothalamic– pituitary– adrenal) axis and the sympatho-adrenal-medullary axes
 - affecting neuroendocrine and immune functions
 - central nervous system effects resulting in pseudo-neurological symptoms and disorders of sleep–wake regulation
 - result in autonomic nervous system dysregulation. (Gupta, 2013)

Trauma and the immune system

- Stress exposure affects the neurotransmitter systems, the neuroendocrine system and the immune system. (Porges, 2011)
- Immune dysregulation and inflammation associated with trauma histories. Mechanism via global and gene-specific DNA methylation. (Smith, et. al., 2011)

Trauma impairs the immune system

- Childhood neglect 4x increased risk of autoimmune disorders
- Sexually abused women 6x increased risk for autoimmune disorders
- Vietnam War veterans 3.3x increased risk for autoimmune disease.
- Stress suppresses the immune function, significantly increases risk for infections, tumors and death. (Porges, 2011)

Chronically stressful emotional patterns could induce inflammatory disease in the gut through the mediation of the psycho-immunological super-system and the activation of pro-inflammatory molecules by stress.

Gabor Mate

When the Body Says No:

Exploring the Stress-Disease Connection, pg. 138

Trauma and epigenetics

- Epigenetic modifications, such as DNA methylation, can occur in response to environmental influences to alter the functional expression of genes in an enduring and potentially, intergenerationally transmissible manner.
- Support includes
 - recent findings of stress-related gene expression
 - in utero contributions to infant biology
 - the association of PTSD risk with maternal PTSD and
 - the relevance of childhood adversity to the development of PTSD.

Yehuda, 2009

Super-utilizers

- (1) Early-life instability and traumas, including parental loss, unstable or violent relationships, and transiency, informed many participants' health and health care experiences;
- (2) Many "high utilizers" described a history of difficult interactions with health care providers during adulthood;
- (3) Over half of the participants described the importance to their well-being of positive and "caring" relationships with primary health care providers and the outreach team.
- According to the Centers for Medicare and Medicaid, 1% of all patients -- the super utilizers -- are responsible for 22% of all health spending.

TABLE 1 Health Problems at Entry to Foster Care⁴¹

Problem or Condition	%
Chronic or untreated physical health condition	35–45
Birth defect	15
Mental health problem	40–95
Developmental/educational:	
Developmental delay in child <5 y	60
Special education placement/academic underachievement	45
Significant dental conditions ^a	20
Family problems ^b	100
Reproductive health issue risks (eg, pregnancy and sexually transmitted infections)	100

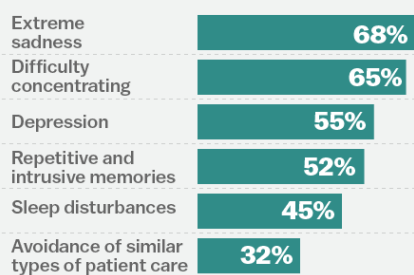
^a Data are from Starlight Pediatrics, personal communication. Sangeeta Gajendra, DDS, MPH, Eastman School of Dentistry, Clinical Chief of Community Dentistry, Rochester NY, 2002.

^b By definition, because that is why they are in foster care.

Health Care Issues for Children and Adolescents in Foster Care and Kinship Care
COUNCIL ON FOSTER CARE, ADOPTION, AND KINSHIP CARE
2015

Doctors and nurses are the "second victims" of medical errors

Symptoms reported by doctors and nurses involved in patient safety investigations



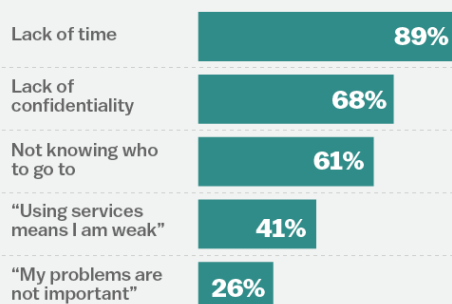
SOURCE: Journal of Quality and Safety in Health Care

Vox

Vox, 2016

The barriers to seeking help

Percentage of doctors who "somewhat agree" or "strongly agree" that these are barriers to seeking help



SOURCE: Journal of Quality and Safety in Health Care

Vox

Vox, 2016

THE BRAIN



Goal of Brain Development

“The goal of brain development is to produce an organism that is well suited to the demands of the environment.”

Teicher, Tomoda & Andersen, 2006

Brain rules

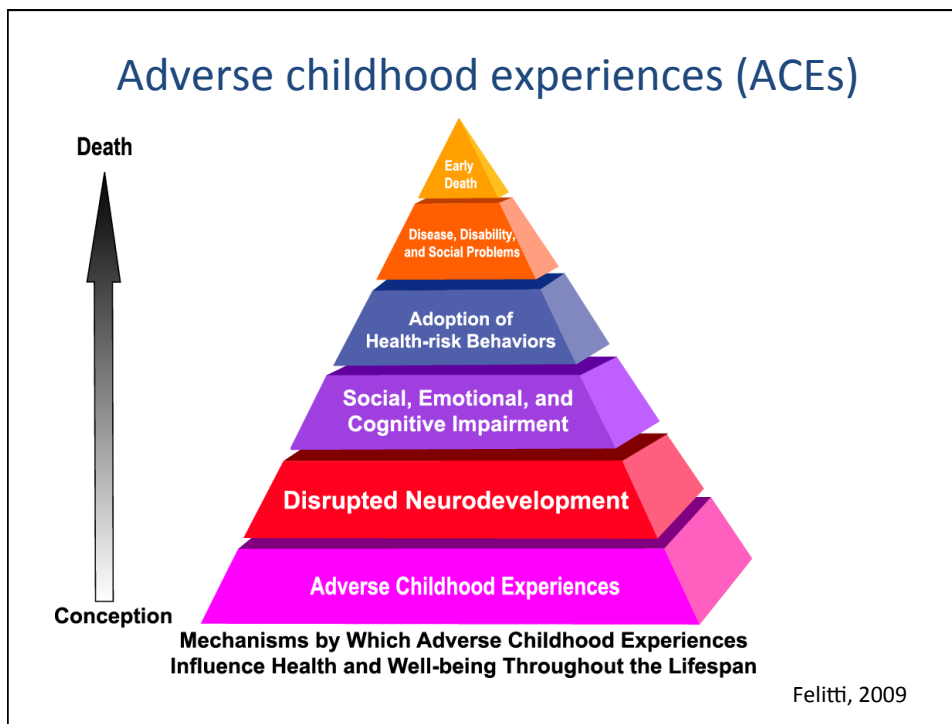
- The human brain is very plastic: Capable of changing in response to patterned, repetitive activation. **Born to learn new skills**
- Once organized, the brain is less responsive or less plastic to the environment. **Harder to re-learn**
- The brain changes in a use-dependent fashion. **Use it or lose it and what fires together, wires together**
- To change the brain (learn new skills), the experience has to activate the part of the brain that controls the function. **Actual use over discussion of use**

Threat alarm

- Raised in an environment of persistent threat, the child will have altered arousal baseline:
 - Traumatized children remain in a physiological state of persistent alarm.
 - Internal state of calm rarely obtained.

Perry, The Amazing Brain

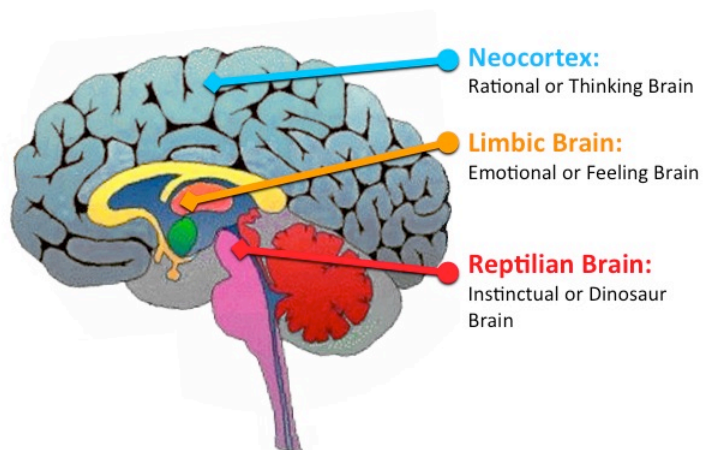
www.childtraumacademy.com/amazing_brain/index.html

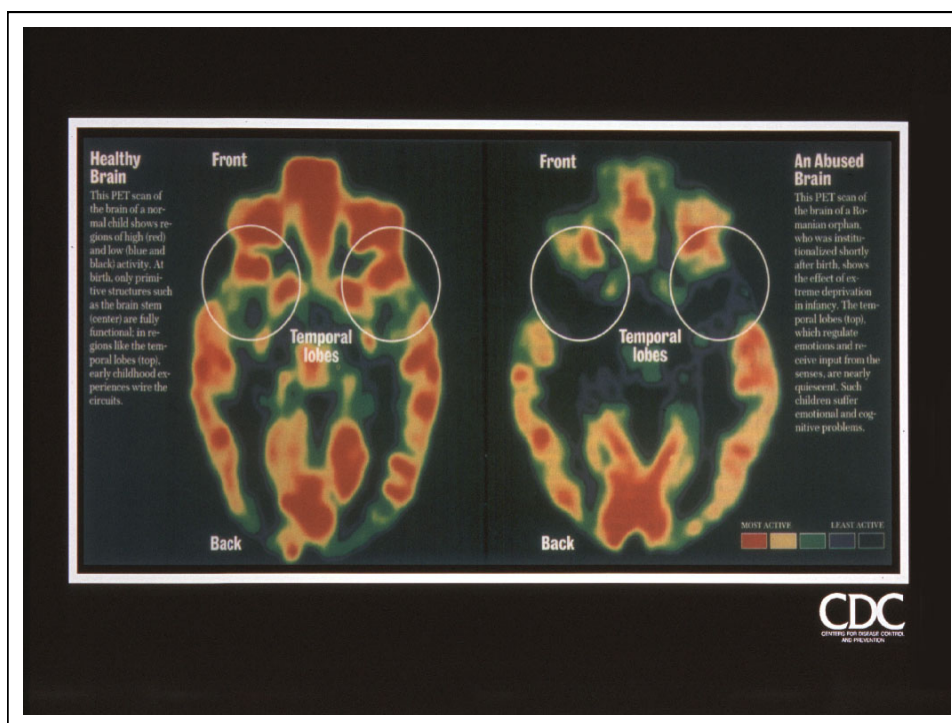


Neurosequential Model of Therapeutics (Perry)

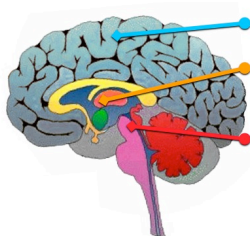
- Developmentally sensitive, neurobiologically informed approach to clinical work, **not a specific therapeutic technique or intervention.**
- The idea is to start with the lowest (in the brain) undeveloped/ abnormally functioning set of problems and move sequentially up the brain as improvements are seen. **Bottom up**
- Examples for brainstem stimulation include dance, music, or massage, especially for children whose persisting fear state is so overwhelming so their brainstem is regulated by safe, predictable, repetitive sensory input. **Self-regulatory**
- An example of a limbic intervention is positive, nurturing, predictable interactions with safe peers, teachers, and caregivers, to bond with others via increased positive relationships or therapeutic relationships. **Interpersonal**
- An example of cortical interventions is narrate in a time sequential manner to understand personal history or consequences. **Cognitive**

Safety – nonverbal and nonrelational





Neurosequential Model of Therapeutics for Children

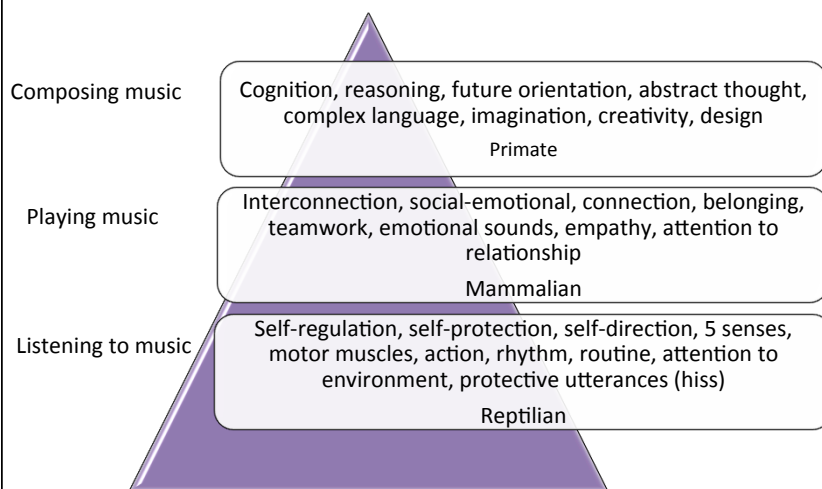


Therapeutic techniques can then be more verbal and insight oriented (cortical) using any variety of cognitive-behavioral or psychodynamic approaches.

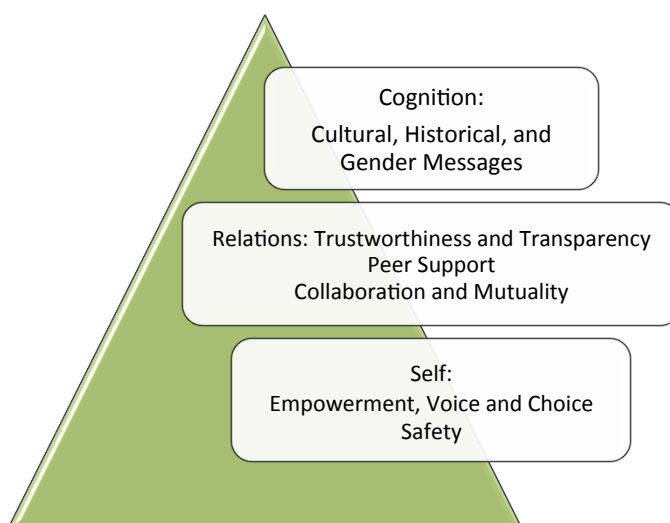
Therapeutic work can then move to more relational-related problems (limbic) using more traditional play or arts therapies and to improve fundamental dyadic relational skills.

Focus first on the poorly organized brainstem/diencephalon and related self-regulation, attention, arousal, and impulsivity. Using any variety of patterned, repetitive somatosensory activities to provide these brain areas patterned neural activation necessary for re-organization: music, movement, yoga (breathing), and drumming or therapeutic massage.

Neuro-sequential model



Trauma-informed values in the NSM



Stages of Trauma Recovery

Stage 1 present

- Establishing Safety:
 - Increase safe coping skills, self-regulation and self-care
 - Decrease trauma symptoms and unsafe behaviors



Stage 2 past

- Remembrance and mourning
 - Honoring the past
 - Mourning the losses



Stage 3 future

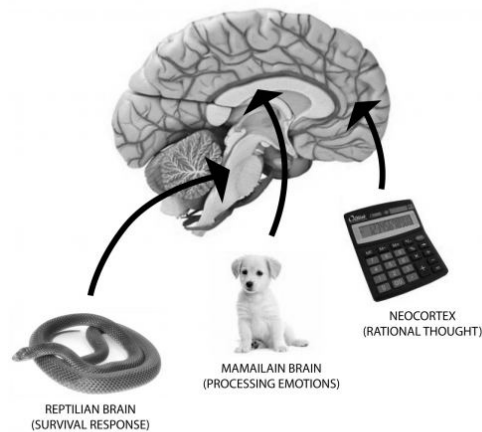
- Reconnection:
 - Reconnecting to one's future
 - Investing in future goals
 - Seeing relationships as enduring

Judith L. Herman, 1992

Neurobiology of the brain

• MacLean's Triune Brain Model

THE THREE BRAINS



Communication channels

- “Gut feelings are an important part of the body’s sensory apparatus, helping us to evaluate the environment and assess whether a situation is safe....Pain in the gut is also a mode of perception. Physiologically, the pain pathways channel information that we have blocked from reaching us by more direct routes. Pain is a powerful secondary mode of perception to alert us when our primary modes have shut down. It provides us with data that we ignore at our peril.”
– Maté, pg. 152

- Specific investigation of the literature suggests that the PNS, virtually independent of the SNS, regulates homeostatic processes and would be most sensitive to stress.

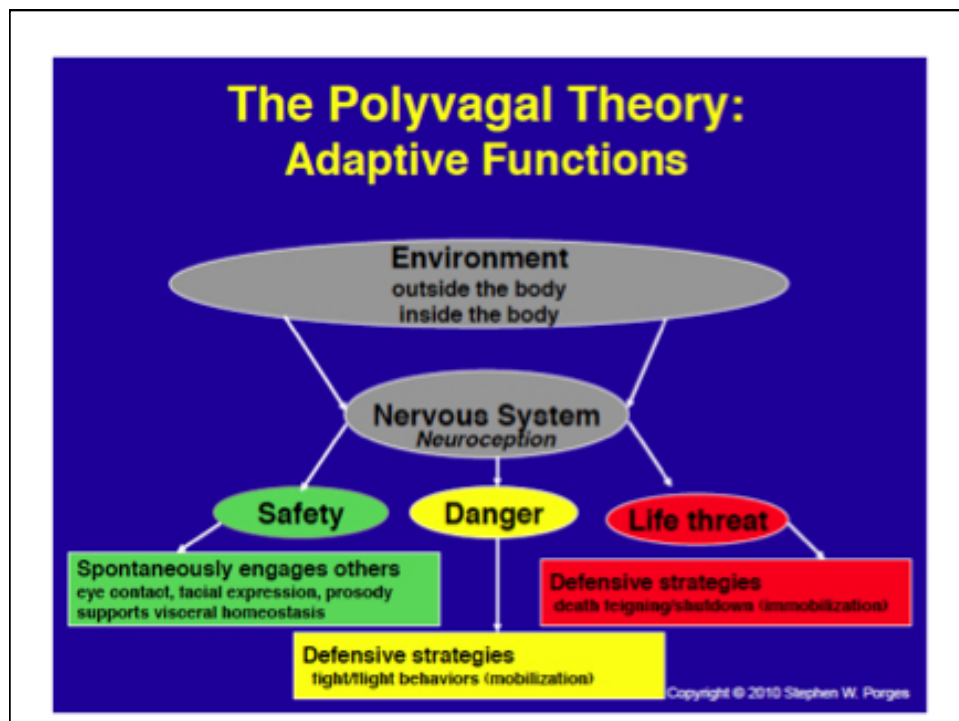
- The vagus and its branches account for approximately 80% of the parasympathetic nervous system, which makes up 80% of the sensory apparatus.

Perceptions

- Proprioception – sense of self in space
- Interoception – functional awareness of what is happening in the body
- Equilibrioception – sense of balance
- Nociception – sense of pain, pain threshold
- Chronoception – sense of time
- Neuroception – sense of safety, danger and life threat

Polyvagal theory – Dr. Stephen Porges

- Part of the current revolution in trauma treatment (present, body-centered, safety-focused, action oriented vs. past-focused talk therapy)
- Fills gaps in traditional simple Autonomic Nervous System model as it applies to trauma
- Mammalian vagal system more complex:
 - Primitive dorsal vagal freeze/shut down system
 - Mammalian ventral vagal social engagement system
 - Vagal brake on sympathetic arousal
 - Neuroception



Neuroception

- The constant, continuous, non-conscious appraisal of **safety**, **danger** and **life threat**.
- Largely outside the realm of awareness and language and inherent in our biology from birth
- Tracking and scanning processes can become overly sensitized to danger and life threat and un-oriented to safety and connection.

Vagal brake

- Infants who have difficulties in regulating the vagal brake (i.e., decreasing cardiac vagal tone) during social/attention tasks later in life have difficulties developing appropriate social interactions requiring reciprocal engagement and disengagement strategies.
- When sympathetic tone (threat) drives the body in an unsustainable way, physiology demands some respite and it often comes in the form of shut-down.
- Unmyelinated dorsal vagal system results in the following nonconscious, automatic responses:
 - Freezing
 - Speechlessness
 - Dissociation
 - Involuntary Defecation
 - Involuntary Urination
 - Fainting
 - Shock
 - Sense of Effort (difficulty to move)
 - “I don’t know”

Neuroceptive Invalidity

- Victims of abuse have state regulation difficulties with a bias toward behavioral states that are self-protective. This potential vulnerability to be defensive may result in difficulties feeling safe with others and in developing trusting social relationships (Porges, pg. 240)
- A history of abuse may “tune” the nervous system to be cautious and prepared for defensive fight-or-flight behaviors, even when real dangers do not exist. (Porges, 239)
- It is possible that neuroception of the [social] environment provides an invalid indicator for individuals with [complex trauma]. Thus, rather than being calm in the presence of another “nonthreatening” human, the ANS is regulated to a state that supports fight and flight as the social defense system. (Porges, 236)

Safety, self-protection, self-regulation

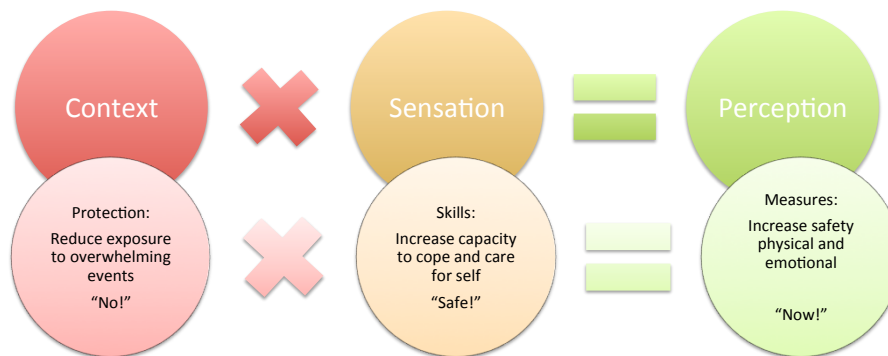
ACTIVELY BUILDING SAFETY SKILLS

- Relational interventions are contraindicated and mastered defense strategies will be used. A dorsal vagal shift is very common in modern life, but often unrecognized, because to others it can appear quite erroneously as being well-behaved or peaceful. “**Functional dissociation**”
- The ventral-vagal (social engagement) system is a way of achieving personal safety, but it **requires a moderate amount of actual safety** to develop or stay employed. Some people are stuck in an unsafe Catch-22!

“Children learn to regulate their behavior by anticipating their caregivers’ responses to them.”

- van der Kolk; Schore 1994

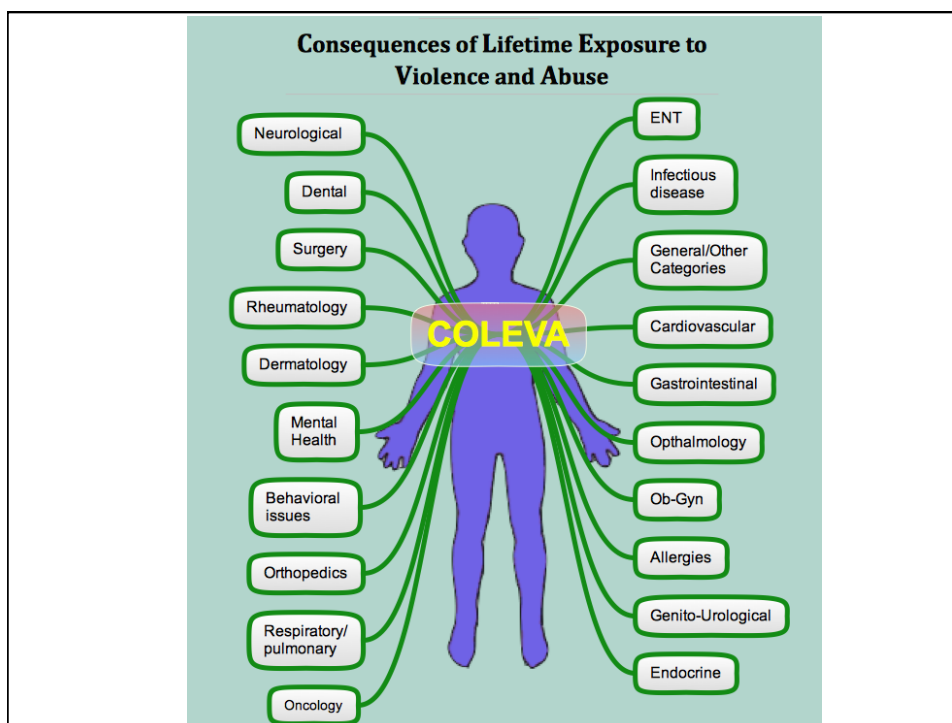
Treatment is neurobiological



Once traumatized people learn to reorient themselves to the present they can experiment with reactivating their lost capacities to physically defend and protect themselves.

Van der Kolk, 2006

- Based on the NSM and the Polyvagal theory, science and practice—including non-Western approaches to trauma healing—are coalescing to recognize the key role of self-regulation as a cost-free, often available method to promote healing, safety, connection and health. Several examples of self-regulatory techniques will be offered and demonstrated, including grounding, EFT, and mindfulness. Aspects to consider related to trauma will be emphasized.

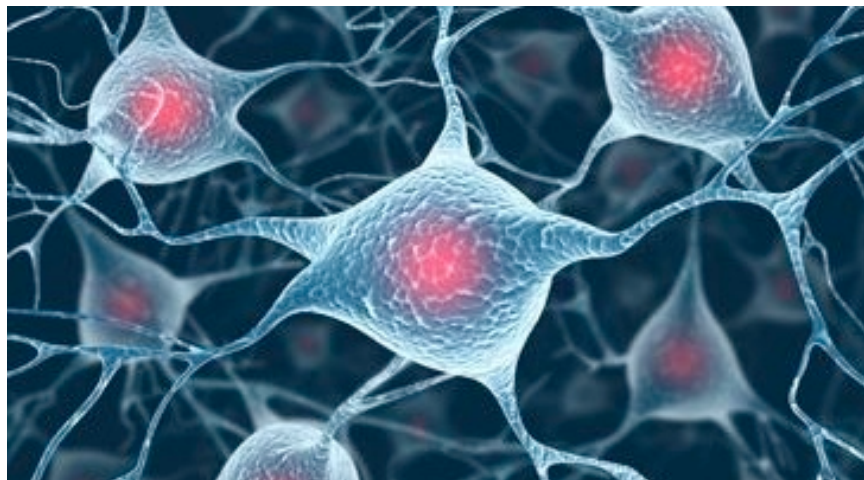


Essential nutrients

- Alimentation (Vitamins, minerals, protein, etc.)
- Water, fluids
- Fresh air, oxygen
- Movement, muscle fatigue
- Sleep, rest
- Shelter
- Clothing
- Needed medical attention
- Sunshine
- Safety

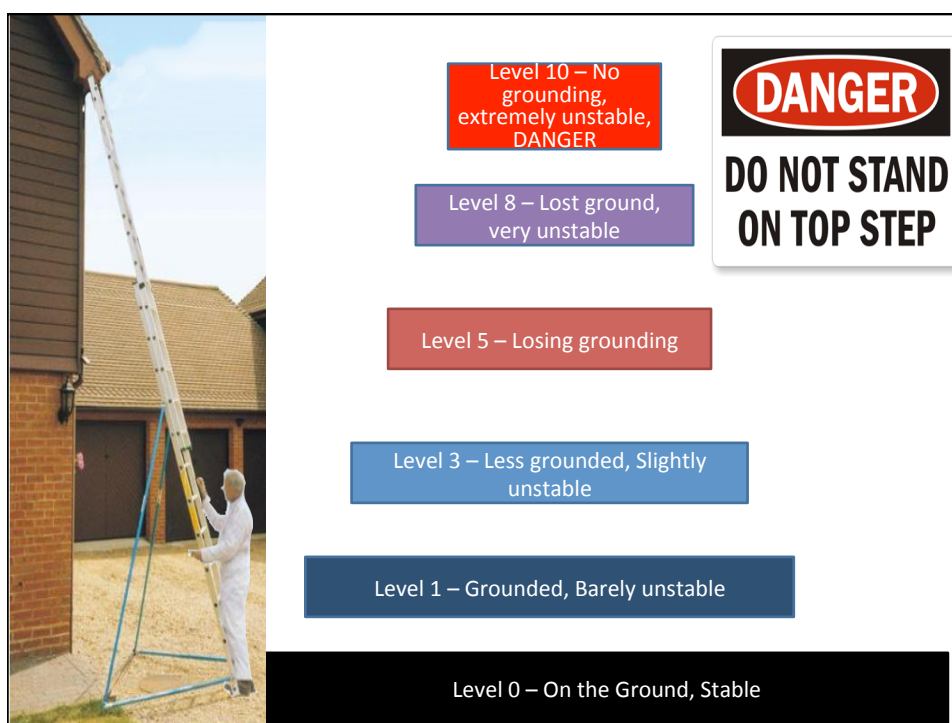
Paying attention:

Noticing **via senses** what actually happens



Intense emotions: Grounding

- Detaching from overwhelming emotional pain.
- Useful when someone experiences flashbacks, overpowering sadness, dissociation, aggression, desire to flee or fight.
- Useful for when experiencing conflict, judgment, time-crunch, fear of being blamed.
 - Present-focused. [Here, now](#)
 - Externally focused. [Physical, real, outside self](#)
 - Concrete, categories, movements and thoughts to calm, soothe and help detach from emotional pain. [Distraction, detachment](#)
- Good for children when having temper tantrums, crying fits, hard time breathing, overwhelmed



Safety, connection, autonomy, interdependence

SAFE CONNECTIONS

“The therapist must first adopt the attitude that nothing, not even the patient's feelings, is more important than safety and stability.... What we want to model is our constant concern and interest in safety and self-care. ”

- Janina Fisher

The Work Of Stabilization In Trauma Treatment, 1999

Safe connection

- Safety, security, stability of this person
- Invitational
- Radical informed consent
- Focus on safely meeting needs
- Coping skills vs. feelings processing
- Grounding, anchoring, self-regulation
- Multiple formats, repetition, practice, handouts
- Balance empathy and accountability

- In the course of successful recovery, it should be possible to recognize a gradual shift from unpredictable danger to reliable safety, from dissociated trauma to acknowledged memory, from stigmatized isolation to restored social connections.
- Judith Herman, "Safety" in Trauma and Recovery, pg. 155

Build active safety skills

- Use the *Safe Coping Skills* sheet.
- Practice self-regulatory skills via scripts and fun activities.
- Distinguish between *physical and emotional* safety.
- *Measure reductions in unsafe behaviors* and use that to assess program's effectiveness w/client.
- Relate all *unsafe behaviors to the person* (do not hold other people's safety as more important).
- Use *Seeking Safety* as a staff development program.
- Use the *Danger Assessment* when domestic violence involved.

Notice this...

"Life-or-death", forever,
never-ending

Permanent, never changing

Dissociation

Self-labels, self-diagnosis ("I
am...")

Freeze when threatened

"Freak out" when informed

Terror

Move to this...

"Here-and-now", right now

Possible, changeable,
attemptable

Awareness

Schemas, information ("Have
you noticed...")

Action when threatened

Options when informed

Safety

(Adapted from Fisher, 2003)

Radical informed consent

- Rights-based
 - Constitution and the Survivors' Bill of Rights
- Invitational
 - “Are you willing” “Could it be helpful?”
- Now (present focus)
 - You can consent or remove consent every session/day
- Ask for agreement (not understanding)
 - Do you agree to these rules? No? What's the disagreement?
- Choices – simple and clear and Constitutional
 - You do not have to answer these questions

Trauma Survivors' Bill of Rights: all about consent



Observe the Constitution

Avoid self-incrimination and protect others from self-incrimination

- Clients involved in the dependency and delinquency systems may choose not to share information with advocates, court personnel, and mental health professionals to protect themselves or others.
- Attorneys and other advocates may choose not to ask about past experiences or request screenings or assessments for fear of uncovering information that could be used against their client.
- Advocates can give copies of trauma-focused guides or handouts to all clients rather than single out particular youth (see <http://www.nctsn.org> for some examples).

Pilinik, L., & Kendall, J. R. (2012)
Victimization and Trauma Experienced by Children and Youth: Implications for Legal Advocates
 Moving From Evidence to Action: The Safe Start Series on Children Exposed to Violence Issue Brief #7.
 Safe Start Center, Office of Juvenile Justice and Delinquency Prevention, Office of Justice Programs, U.S. Department of Justice.

- Among patients with high rates of trauma load, retention level increased from 29% to 80% when education about alcohol and trauma was added to treatment as usual. (Dore, 2012)

The limits of talk

“The imprint of trauma doesn’t ‘sit’ in the verbal, understanding, part of the brain, but in much deeper regions - amygdala, hippocampus, hypothalamus, brain stem -which are only marginally affected by thinking and cognition... then to do effective therapy, we need to do things that change the way people regulate these core functions, which probably can’t be done by words and language alone.”

Van der Kolk
The Body Keeps Score

Art Therapy



Group healing

- B van der Kolk recommends choral singing as trauma tx.
- NADA protocol for ear acupuncture.
- Many non-Western cultures have healing traditions that activate and use physical movement and breath:
 - Yoga, chi qong, meditation, and tai chi, all of which claim to regulate emotional and physiological states.
- Trauma-informed yoga shown to reduce PTSD symptoms (Emerson, 2009)
- Working with sensation and movement has been extensively explored in many techniques:
 - mindfulness, focusing, sensory awareness, Feldenkrais, Rolfing, the F.M. Alexander Technique, body–mind centering, somatic experiencing, Pesso-Boyden psychotherapy, Rubenfeld synergy, Hakomi, and many others.
- Self-defense classes, kick-boxing, dance and theatre also work in similar ways.

WHAT WE TEACH

Capacitar offers simple effective wellness skills such as:

- Body movement
- Acupressure for pain & stress
- Fingerholds for emotions
- Breathwork & visualization
- Emotional Freedom Tapping.

Capacitar.org



USA: Domestic Violence



Rwanda: HIV/Trauma



Northern Ireland: Trauma Counselors

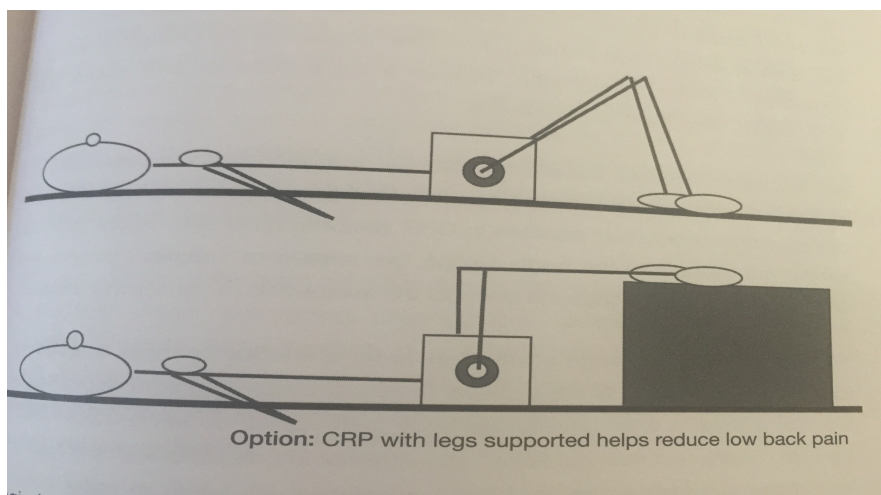


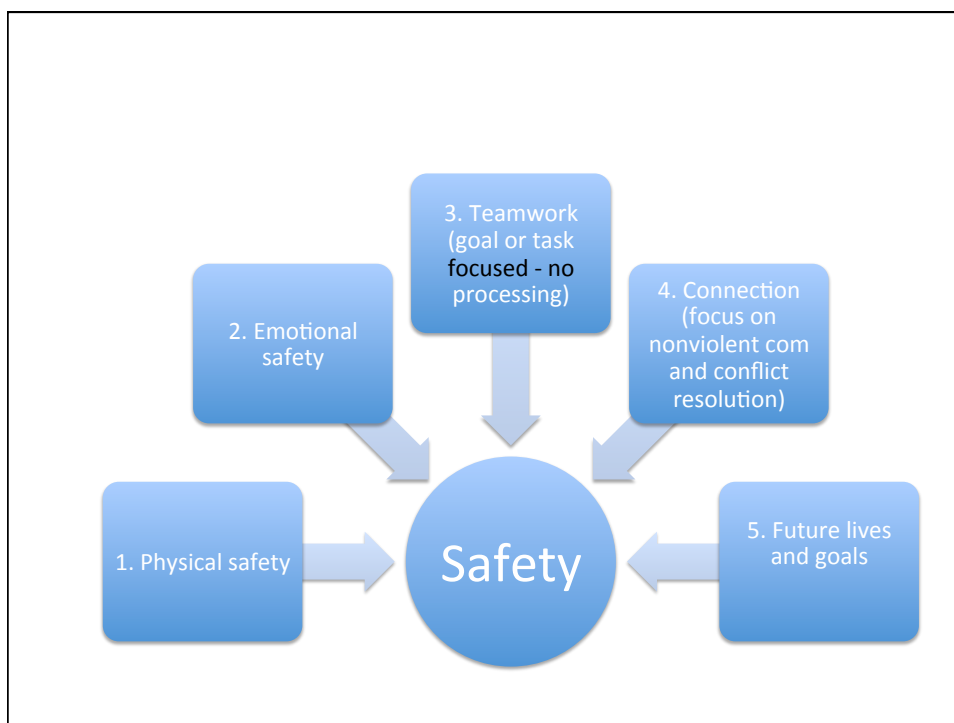
El Paso/Juarez: Border Outreach

Psoas

- Considered an involuntary muscle, it cannot be consciously controlled.
- The psoas plays an important role in the survival response of the organism.
- Fear is the only instinct that has the power to immobilize. Fetal curl.
- Treatments: Constructive Rest Position, Rolfing, Feldenkrais, Trauma Release Exercises (trembling), Dancing, Rocking chair, Cycling

Constructive Rest





Bibliography

- The Body Remembers: The psychophysiology of trauma and trauma treatment, Rothschild, 2000
- When the Body Says No: Exploring the stress-disease connection, Maté, 2003
- The Body Never Lies: The lingering effects of hurtful parenting, Alice Miller, 2006
- Trauma and the Body: A sensorimotor approach to psychotherapy, Ogden, et al., 2006
- The Impact of Early Life Trauma on Health and Disease, Lanius, et al. 2010
- The PolyVagal Theory: Neurophysiological foundations of emotions, attachment, communication, and self-regulation, Porges 2011
- The Body Keeps the Score: Brain, mind and body in the healing of trauma, van der Kolk, 2014
- Neurobiologically Informed Trauma Therapy with Children and Adolescents, Linda Chapman, 2014
- It Didn't Start with You: How inherited family trauma shapes who we are and how to end the cycle, Wolynn, 2016

Recommended reading

- Brain Rules, John Medina
- Boy Raised as a Dog, Bruce Perry
- The Brain that Changes Itself, Norman Doidge
- Developmental Traumatology, Part 2: Brain Development. M.D. De Bellis, M.S. Keshavan, D.B. Clark, B.J. Casey, J.N. Giedd, A.M. Boring, K. Frustaci and N.D. Ryan in Biological Psychiatry, May 15, 1999.
- Wounds That Time Won't Heal: The Neurobiology of Child Abuse, Martin H. Teicher in Cerebrum, Fall 2000.
- McLean Hospital: www.mcleanhospital.org

Youtube videos

- Comparison of the sympathetic/parasympathetic nervous systems
 - <https://www.youtube.com/watch?v=1JTz5WQDWd4>
- Gabby's grounding video
 - <https://www.youtube.com/watch?v=88AuyGF2J3I>
- PolyVagal Theory – Dr. Stephen Porges
 - <https://www.youtube.com/watch?v=MKkDAOW2yd4>

Thank you!

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- www.trauma-informed-california.org
- 916-267-4367

California Center of Excellence

for Trauma Informed Care